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for All Hams

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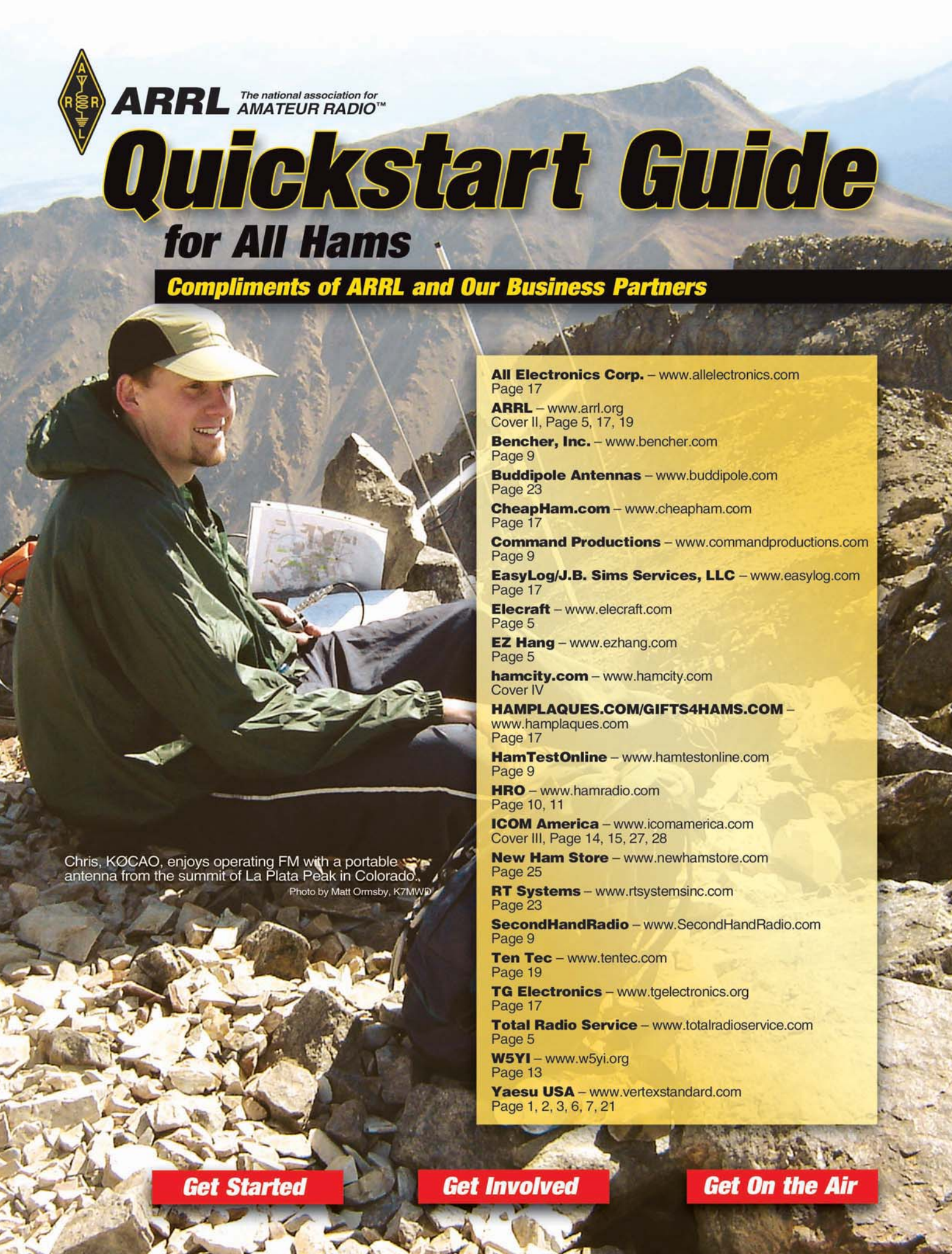

Chris, KØCAO, enjoys operating FM with a portable antenna from the summit of La Plata Peak in Colorado.
Photo by Matt Ormsby, K7MWD

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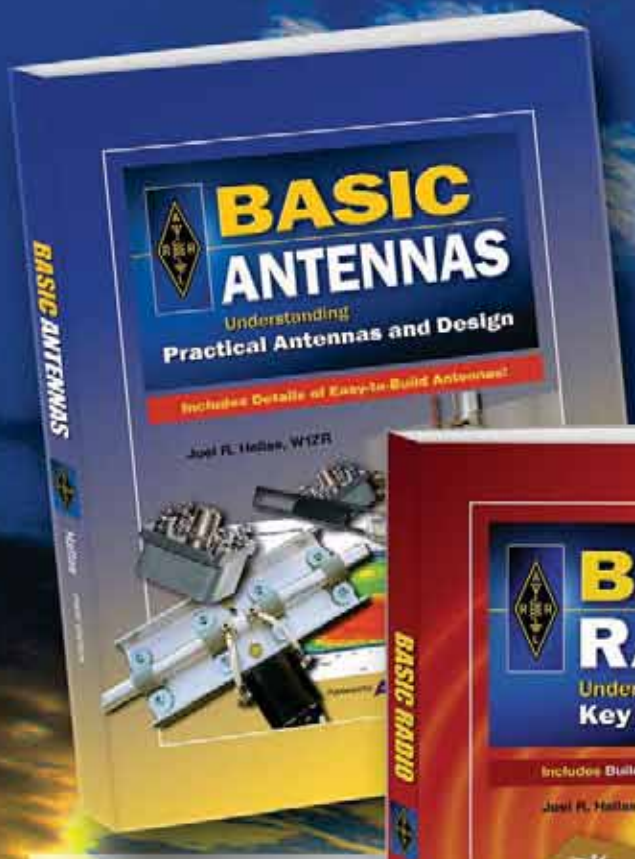

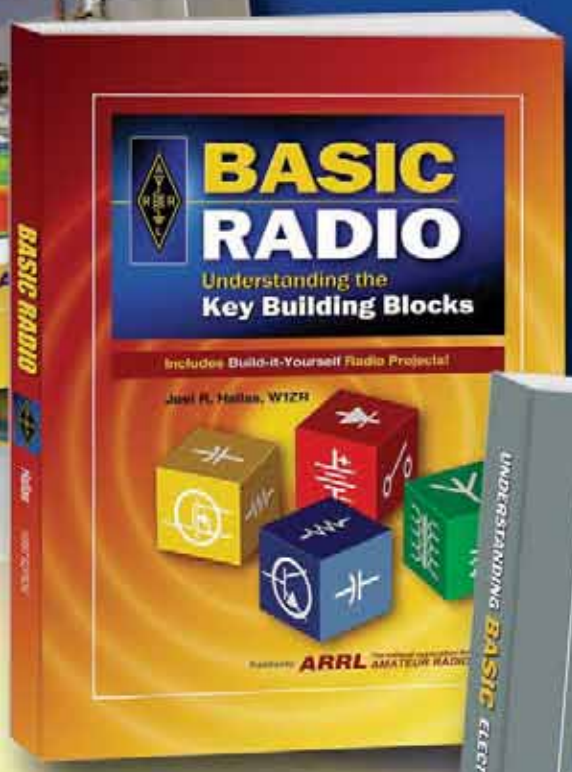

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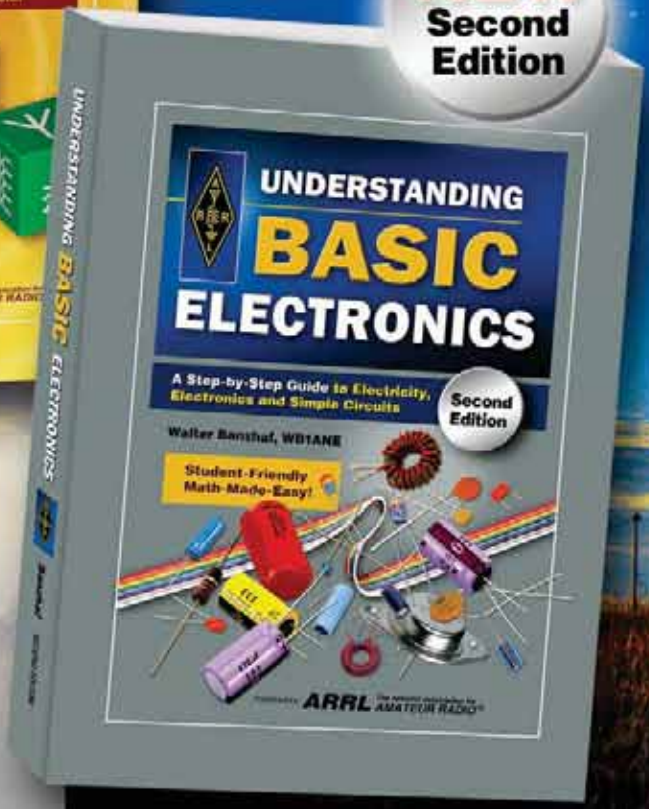

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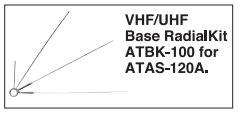

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Navigation (with GPS antenna unit attached)

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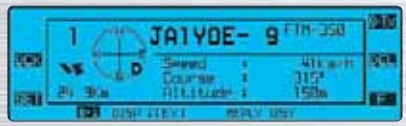

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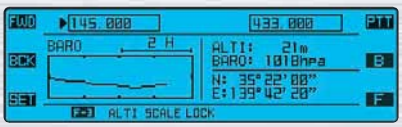

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FM and Repeaters: Leave the Static Behind

A Great Way to Enjoy Conversations On the Go

By Steve Ford, WB8IMY
Editor

Do you remember learning about FM while you studied for your license? If not, here is a refresher course in five paragraphs.

FM stands for *frequency modulation*. When you modulate a signal, you change it in a way that allows it to carry information—voices, data, images or whatever. With FM, we take a signal and modulate it by shifting its frequency back and forth.

The great advantage of FM is found in how it is received. An FM receiver *de*modulates a signal by looking for frequency shifts. Most of the noise in our environment is *not* frequency modulated. So, the FM receiver extracts the information from the FM signal and, by default, leaves out most (or all) of the noise. The result is a clean signal without static crashes, sputtering motor noises and so on. That's why FM has long been the best choice for high-fidelity audio broadcasting (although that is changing now that digital audio broadcasting and satellite radio have appeared). It is also the reason why hams enjoy using FM—signals are clear and noise is nonexistent.

For every advantage there is a disadvantage, and FM is no exception. An FM receiver requires a strong signal for *full quieting* (noise free) reception. Anything less than the required strength results in noise, and the weaker the signal, the greater the noise. In fact, it is quite difficult to understand voices when an FM signal becomes weak.

Because of this disadvantage, FM is best for local use where distances are relatively short and signals are strong. FM is a poor choice for long-distance work. In fact, it is so poor that under weak signal conditions, direct point-to-point *simplex* communication can be a challenge. With directional antennas, substantial output power and no tall obstacles between them, two stations can enjoy an FM contact with clear signals over 50 miles or more. Add buildings or hills, however, and the effective distance decreases.

The solution for limited FM range is to build an automated station with lots of power, a sensitive receiver and great antennas. Put that station on top of the nearest mountain or skyscraper (or elevate its antennas with a tall tower) and use it to relay FM signals throughout the entire area. Such Amateur Radio relay stations exist by the *thousands* throughout the United States and they are known as *repeaters*.

This tower supports the antennas for the KC7RJK repeater on 145.5 MHz in Eugene, Oregon. With these highly elevated antennas, the repeater enjoys wide coverage.

Photo by KC7RJK

Repeaters

A repeater is similar to any other Amateur Radio station—it uses a transmitter, a receiver and an antenna. The magic is in the fact that the receiver and transmitter in a repeater are on different frequencies and the output of the receiver is fed to the input of the transmitter. Thus, everything that the receiver hears is retransmitted *simultaneously* ("repeated") by the transmitter. A repeater effectively listens and "talks" at the same time! In communication circles, this is known as operating *full duplex*.

Of course, your radio's receiver and transmitter are also tuned to different frequencies (the opposite of those on the repeater). Your radio transmits on the repeater's *input* frequency and receives on the repeater's *output* frequency. The same is true of the station you are talking to. The result is that the repeater is your conversational middleman—it listens to you and relays everything you say to the other station *while you are saying it*. When it's the other station's turn to talk, the repeater does the same for him, listening to everything and retransmitting to you.

Thanks to the repeater, a conversation that might have otherwise been impossible is now possible. A repeater greatly extends the range of your radio. In the case of a handheld transceiver, it may expand it from a few miles to tens or even hundreds of miles.

Frequency offset—the difference between the frequency on which the repeater hears and transmits—varies by repeater band. On 144 MHz the common offset is 600 kHz; on 222 MHz it's 1.6 MHz and on 450 MHz it's 5 MHz. This frequency separation is generally built into a modern transceiver's memory so it's transparent to the user. The radio chooses the offset depending upon which band is selected.

A repeater system may also include connections to receiver and transmitter combinations on other bands. For example, a 2-meter repeater linked to the 70-cm band may receive on 147.69 MHz and transmit on 147.09, while it also receives on 449.625 and transmits on 444.625. If a signal is present on 147.69 or on 449.625, it is retransmitted on both 147.09 and 444.625. These *crosslinked* repeaters may include coverage for several bands. Such systems are capable of operating on all bands at all times, or can be set up to have remote control selectability for the various links.

Special Tones

More often than not, especially in today's operating environment, you will find open repeaters that require the use of special codes or low-frequency *subaudible tones* to gain access. The reason for tone encoding the access is to prevent interference, not to limit users of the system. In cases where extraneous transmissions often activate the repeater, the use of tone encoding is the only practical way to resolve the problem. How is access to these repeaters controlled? Most often, via a technique called *continuous tone-controlled squelch system* (CTCSS). (Many hams refer to CTCSS as *PL*—a Motorola trademark that stands for *Private Line*.) When a transmitter is configured for CTCSS, it sends a subaudible tone along with the transmitted voice or other signals. The frequency of the CTCSS tone is below the lowest audio frequency other stations will pass to their speakers, but it's sensed by a suitably equipped repeater. The repeater is programmed to respond only to carriers that send the proper tone. This effectively locks out signals that don't

Continued on Page 8

Who Builds Repeaters?

Repeaters are expensive devices. The equipment alone can cost thousands of dollars. When you add the cost to rent space on a building or tower, and the expense of supplying electricity and possibly a telephone line or Internet connection, you're looking at serious money. Individuals can and do own repeaters, but most of these systems are sponsored and financed by ham clubs.

In most cases, you don't need to be a member of the sponsoring club to use their repeater. If you find that you are operating through a particular repeater quite a bit, however, it is a good idea to join the club that supports it. There are more than 2000 ARRL Affiliated Clubs, many of which sponsor repeaters. You can find an Affiliated Club near you by searching on the ARRLWeb at **www.arrl.org**.

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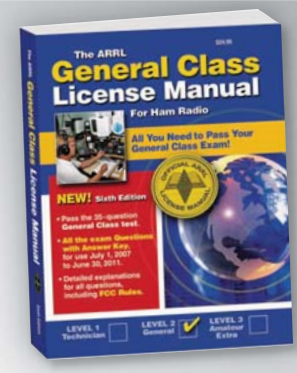

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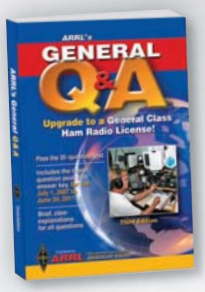

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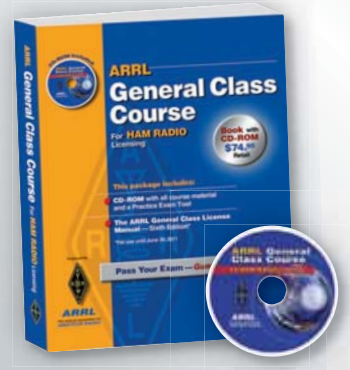

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FM and Repeaters: Leave the Static Behind

Continued from Page 4

carry the correct CTCSS tone. Modern VHF and UHF transceivers include the necessary circuitry to generate CTCSS tones, so if you know the one you need, you can simply program it on your rig.

Alphanumeric names are used to designate the tones, and the Electronic Industries Alliance (EIA) has developed 50 standard CTCSS tone frequencies. A list of current CTCSS tones is shown in **Table 1**.

Table 1
CTCSS Tone Frequencies

The purpose of CTCSS (*PL*) is to reduce co-channel interference. CTCSS-equipped repeaters respond only to signals that include the CTCSS tone required for that repeater.

When using CTCSS, your radio will transmit these very low audio tones while you are talking, but no one will hear them except the repeater. Publications such as the *ARRL Repeater Directory* list the CTCSS tones used by specific repeater systems. If you're in doubt, ask a local ham.

The tone frequencies shown are in hertz (Hz)

67.0	85.4	107.2	131.8	159.8	177.3	196.6	225.7
69.3	88.5	110.9	136.5	162.2	179.9	199.5	229.1
71.9	91.5	114.8	141.3	165.5	183.5	203.5	233.6
74.4	94.8	118.8	146.2	167.9	186.2	206.5	241.8
77.0	97.4	123.0	151.4	171.3	189.9	210.7	250.3
79.7	100.0	127.3	156.7	173.8	192.8	218.1	254.1
82.5	103.5						

Finding a Repeater

To use a repeater, you must know one exists. There are various ways to find a repeater. Modern transceivers often include a scan mode that searches for activity. Some transceivers will even place active frequencies in their memories automatically.

There are also several very good listings (both written and software based) that can provide you with all the information available for repeaters in your area. The ARRL publishes *The ARRL Repeater Directory*, an annual, comprehensive listing of repeaters throughout the US, Canada and other parts of the world. The ARRL also publishes *TravelPlus*, a map-based CD-ROM that allows you to trace your proposed route on a color map and print a list of repeaters along the way. In addition to simply identifying local repeater activity, these directories are perfectly suited for finding repeaters during vacations and business trips. You can find more information or place an order on the ARRLWeb at **www.arrl.org**. Once you find a repeater to use, take some time to listen and familiarize yourself with its operating procedures.

"Nobody Talks to Me!"

As a new ham you may find that the repeater stays awfully quiet after you say that you are "monitoring." You've announced your presence, so why won't anyone talk to you?

Part of the problem is timing. Repeaters are most active when people are traveling to and from work in the early morning and late afternoon. At other times, and on weekends, there aren't as many stations listening.

The other issue is social. Remember that repeaters are often placed on the air by clubs and they are used for local or regional communication, usually among club members and others who have formed friendships over months and years. As the new person on the repeater, you are a stranger. Some people are reluctant to strike up conversations with people they don't know well, so they may not respond to your invitation to chat.

The solution to the timing problem is to simply use the repeater when it is most active. That's easy. The social problem is a bit harder to solve, but it *can* be solved. You need to attend club meetings. Shake some hands and introduce yourself. Ask questions (veteran hams enjoy answering questions). Volunteer to assist in club activities. By doing all these things, you'll gradually shed your "stranger" label and become part of the group, and a well-known voice on the air.

Your First Transmission

If the repeater is quiet, pick up your microphone, press the switch, and transmit your call sign.

For example, "This is W1VT monitoring."

This advises others on frequency that you have joined the system and are available to talk. After you stop transmitting, the repeater sends an unmodulated carrier for a couple of seconds to let you know it is working. Chances are that if anyone wishes to make contact they will call you at this time. Some repeaters have specific rules for making yourself heard, but usually your call sign is all you need.

If you want to join a conversation already in progress, transmit your call sign during a break between transmissions. The station that transmits next should acknowledge you. Don't use the word BREAK to join a conversation. BREAK generally suggests an emergency and indicates that all stations should stand by for the station with emergency traffic.

If you want to see if your buddy across town is on the air, call him like this:

"N1ND this is W1VT."

If the repeater is active, but the conversation in progress sounds as though it's about to end, be patient and wait until it's over before calling another station. If the conversation sounds like it's going to continue for a while, transmit your call sign between transmissions. After one of the other hams acknowledges you, politely ask to make a quick call on the repeater. Usually, the other stations will allow you this brief interruption. Make your call short. If your friend responds to your call, ask him to move to a simplex frequency or another repeater, or to stand by until the present conversation is over. Thank the other users for letting you interrupt them to place your call.

Brevity

Always try to keep transmissions as short as possible. Short transmissions permit more people to use the repeater. All repeaters promote this practice by having timers that shut down the repeater temporarily whenever the length of a transmission exceeds a preset time limit. With this in the back of their minds, most users keep their transmissions brief. When a long-winded ham causes a repeater to shut down, this is known as *timing out* the repeater and it is usually embarrassing.

Learn the length of the repeater's timer and stay well within its limits. The length may vary with each repeater; some are as short as 15 seconds and others are as long as three minutes. Some repeaters vary their timer length depending on the amount of traffic on frequency: the more traffic, the shorter the timer. Another purpose of a repeater timer is to prevent extraneous signals (or someone accidentally sitting on the PTT button on their mobile microphone) from holding the repeater on the air continuously. This could potentially cause damage to the repeater's transmitter.

Because of the nature of FM radio, if more than one signal is on the same frequency at one time, it creates a muffled buzz or an unnerving squawk. If two hams try to talk on a repeater at once, the resulting noise is known as a *double*. If you're in a roundtable conversation, it's easy to lose track of which station is next in line to talk. There's one simple solution to eradicate this problem forever: *Always pass off to another ham by name or call sign*. Saying, "What do you think, Jennifer?" or "Go ahead, N1TDY" will eliminate confusion and help avoid doubling. Try to hand off to whomever is next in the queue, although picking out anyone in the roundtable is better than just tossing the repeater up for grabs and inviting chaos!

The key to professional-sounding FM repeater operation is to be brisk and to the point, and to leave plenty of room for others. That's why some repeaters include a *courtesy tone* or *courtesy beep*. You'll hear it when a station stops transmitting—the repeater pauses slightly, and then beeps. You are not supposed to begin talking until you hear the beep. This forces everyone to pause between transmissions to allow another station to break in. If you *do* transmit before hearing the courtesy tone, the repeater's timer won't reset. The result can be an embarrassing *time out!*

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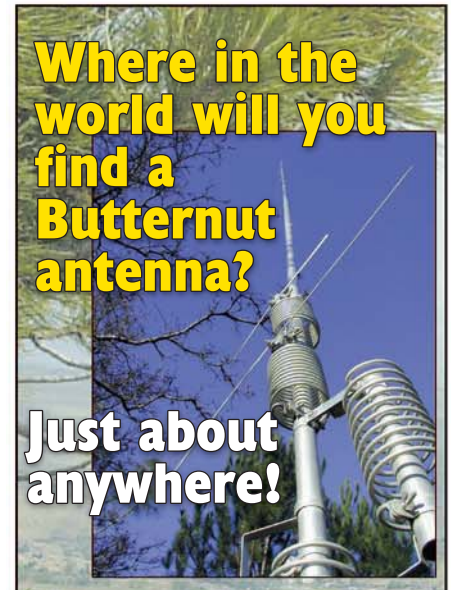

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Build a Portable Ground Plane Antenna

Need a Better Antenna for Your Handheld Radio? Here's the Answer.

By Zack Lau, W1VT
ARRL Laboratory Engineer

The "rubber ducky" antennas common on handheld VHF and UHF FM transceivers work fine in many situations. That's no surprise, considering that repeaters generally reside high and in the clear so you and your handheld won't have to "reach" all that far. Sometimes, though, you need a more efficient antenna that's just as portable as a handheld. Here's one: A simple ground plane antenna that you can build for 146, 223 or 440 MHz in no time flat. It features wire-end loops for safety (sharp, straight wires are hazardous) and convenience (its top loop lets you hang it off high objects for best performance).

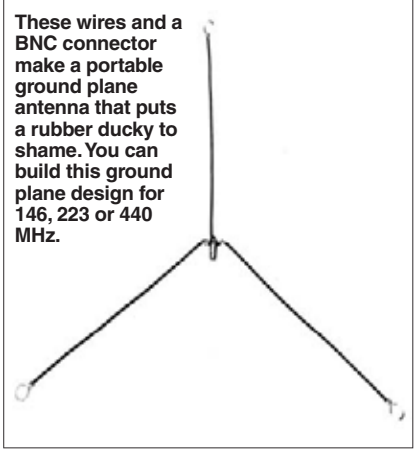
What You Need to Build One

All you'll need are wire (single conductor, no. 12 THHN), solder and a female coax jack for the connector series of your choice. Many hardware stores sell THHN wire—that is, thermal-insulation, solid-copper house wire—by the foot. Get 7 feet of wire for a 146-MHz antenna, 5 feet of wire for a 223-MHz antenna or 3 feet of wire for a 440-MHz antenna.

The only tools you need are a 100-watt soldering iron or gun; a yardstick, long ruler or tape measure; a pair of wire cutters; a ½-inch-diameter form for bending the wire loops (a section of hardwood dowel or metal tubing works fine), and a file (for smoothing rough cut-wire edges and filing the coax jack for soldering). You may also find a sharp knife useful for removing the THHN's insulation.

Building the Antenna

To build a 146-MHz antenna (the most popular frequency band for FM operating), cut three 24⅝-inch pieces from the wire you bought. To build a 223-MHz antenna, cut three 17⅝-inch pieces. To build a 440-MHz antenna, cut three 10⅝-inch pieces.



These wires and a BNC connector make a portable ground plane antenna that puts a rubber ducky to shame. You can build this ground plane design for 146, 223 or 440 MHz.

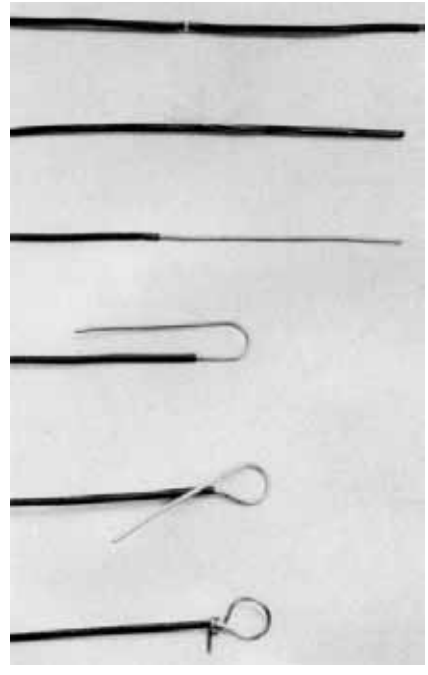


Figure 1—Making loops on the antenna wires requires that you remove exactly 4 inches of insulation from each. Stripping THHN insulation is easier if you remove its clear plastic jacket first.

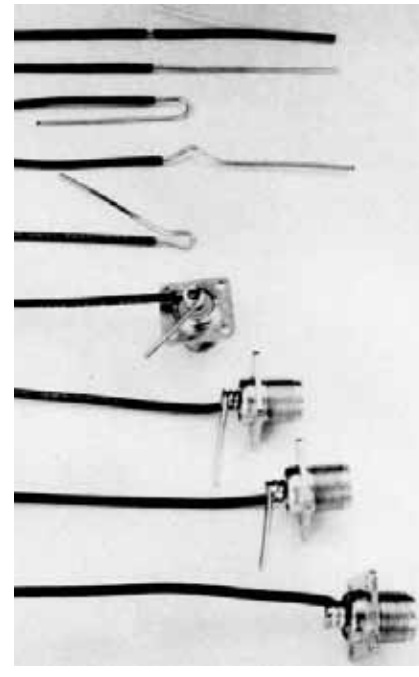


Figure 2—Remove exactly 3 inches of insulation to attach to vertical wire to the coax connector center pin. This photo shows an SO239 (UHF series) jack. Use whatever your application requires.

The photos show how to build the antenna, but they may not communicate why the cut lengths I prescribe are somewhat longer than the finished antenna dimensions. Here's why: The extra wire allows you to bend and shape the loops by hand. The half-inch-diameter loop form helps you form the loops easily.

Make the End Loops First

Form an end loop on each wire as shown in Figure 1. Strip exactly 4 inches of insulation from the wire. Using your ½-inch diameter form, bend the loop and close it—right up against the wire insulation—with a two-turn twist as shown in the bottommost example in Figure 1. Cut off the excess wire (about ½ inch). Solder the two, turn and twist. Do this for each of the antenna's three wires.

Attach the Vertical Wire to the Coax-Jack Center Pin

Strip exactly 3 inches of insulation from the unlooped end of one of your wires and follow the steps shown in Figure 2. Solder the wire to the connector center conductor. Soldering the wire to a coaxial jack's center pin takes considerable heat. A 700- to 750-°F iron with a large tip, used in a draft-free room, works best. (Don't try to do the job with an iron that draws less than 100 watts.) Cut off the extra wire (about ½ inch).

Attaching the Lower Wares to the Connector Flange

Strip exactly 3 inches of insulation from the unlooped ends of the remaining two wires. Loop their stripped ends—right up to the insulation—through opposing mounting holes on the connector flange. Solder them to the connector. (You may need to file the connector flange to get it to take solder better.) Cut off the excess wire (about 2¼ inches per wire). This completes construction.

Adjusting the Antenna for Best Performance

Bend the antenna's two lower wires to form 120° angles with the vertical wire. (No, you don't need a protractor. Just position the wires so they just about trisect a circle.) If you have no means of measuring SWR at your antenna's operating frequency, stop adjustment here and start enjoying your antenna! Every handheld I know of should produce ample RF output into the impedance represented by the antenna and its feed line.

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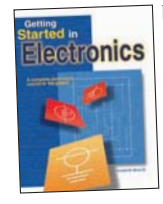

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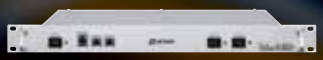

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IC-2200H
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Put Your New License to Work in Service to Your Community

Sometimes Amateur Radio is More than a Hobby.

By Steve Ford, WB8IMY
Editor

Among all the activities that we usually call "hobbies," Amateur Radio is unique in that it has a strong public service component. From the earliest days of radio, hams have played key roles in providing communications in time of need. We typically put our skills to use in emergencies when normal communications have been disrupted. For example, when Hurricane Katrina devastated New Orleans in 2005, hams jumped into action to fill the communication gaps. Our service was so valuable, we were praised in the national news media.

Where Do You Fit In?

Amateurs have the equipment, the skills, and the frequencies necessary to create expedient emergency communication networks under poor conditions. They are licensed and pre-authorized for national and international communication. Hams have the ability to rapidly enlarge their communication capacity to meet growing needs in an emergency, something commercial and public safety systems cannot do. Many of the skills are the same ones used in everyday ham activities.

However, just having radios, frequencies, and basic radio skills is not enough. Certain emergency communication skills are very different from those you use in your daily ham radio life. The ARRL offers courses to help you hone your emcomm skills. You can learn more about these courses online at www.arrl.org.

As you might expect, technical and operating skills are critical. Just as important, though, is your ability to function as a team player within your own organization, and the organization you are serving. You'll often hear these organizations referred to as "served agencies."

Amateur Radio Emergency Service (ARES)

Among the largest and oldest emcomm groups is ARES, a program sponsored by the American Radio Relay League (ARRL) since 1935. Any amateur can become a member of ARES—including you! There is no cost involved; all you need is a sincere desire to serve.

ARES is part of the League's field organization, which is composed of "Sections." (See the ARRL Web site at www.arrl.org for complete details.) Most Sections are entire states, but some larger states have two or more Sections.

The elected Section Manager (SM) appoints the ARES leadership. The top ARES leader in each Section is the Section Emergency Coordinator (SEC).

Some larger Sections, like Wisconsin, Michigan and Florida, are further divided into two or more Districts. In this case, each District is guided by a District Emergency Coordinator (DEC), working directly under the SEC.

The next subdivision within ARES is the "county" or similar region assigned to an Emergency Coordinator (EC). Most ECs will have one or more Assistant Emergency Coordinators (AEC), who may have responsibility for specific tasks or cities. A large city with complex needs may have its own EC, but most towns and smaller cities will have an AEC.

ARES Mutual Assistance Team (ARESMAT)

When a communication emergency lasts longer than a day or two, or when the scale of the emergency is beyond the ability of a local ARES group to handle, help can be requested from neighboring areas. The ARESMAT concept was created to meet that need. These teams consist of hams who are willing and able to travel to another area for a period to assist ARES groups based in the disaster area. They may also bring additional resources in the form of radios, antennas and other critical equipment. If you travel to another area as part of an ARESMAT, remember that the local group is still in charge—you are there to do what they need done. In a sense, the host ARES group becomes a "served agency."

❑ ***How do I get involved in emergency communications?***
Contact your ARRL Section Emergency Coordinator for information about emergency communications groups in your area.
www.arrl.org/sections

❑ ***What emergency communication training does the ARRL offer?***
- ❍ Course No. EC-001 Intro to Emergency Communications – Level 1/Basic. Basic training all ARES® volunteers need to know.
- ❍ Course No. EC-016 Public Service and Emergency Communications Management for Radio Amateurs. Training for leaders involved with recruiting, training, coordinating and managing ARES teams.

www.arrl.org/courses-training

❑ ***What kind of deployment gear will I need?***
Build a "Go-Kit" to hit the ground running when called upon. The contents of your kit will depend on local needs and the amount of time deployed. Emergency communication volunteers are encouraged to use standard ARES® deployment vests and hats.
www.arrl.org/shop/Emergency-Communications

❑ ***What are Ham Aid kits?***
Ham Aid helps loan Amateur Radio equipment kits to disaster areas where additional resources are needed. There are three different kits: the command station (HF radio, amplifier, repeater, and WinLink), VHF kit, and HF kit. The ARRL Ham Aid Fund is supported by businesses, manufacturers and individual contributions.
www.arrl.org/arrl-donation-form

❑ ***Recommended Publications and Resources***
www.arrl.org/shop

Basic Level –
- ❍ The ARRL Emergency Communications Library CD-ROM
- ❍ ARES Field Resources Manual
- ❍ ARRL Radiograms
- ❍ The ARRL Emergency Communications Handbook

Advanced Level –
- ❍ VOIP: Internet Linking for Radio Amateurs
- ❍ GPS and Amateur Radio
- ❍ ARRL's VHF Digital Handbook
- ❍ Emergency Power for Radio Communications

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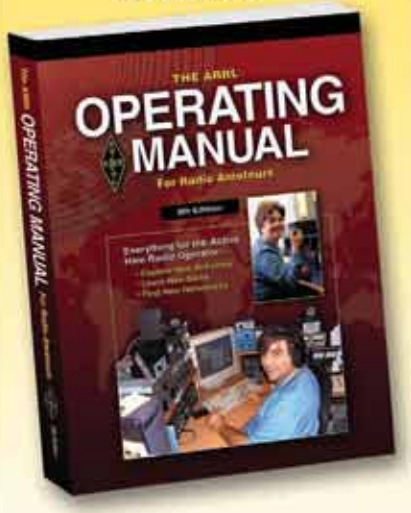

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Communicating with Other Hams

Contact Basics: Good Amateur Practices

Q-Signals

Q-signals are a system of radio shorthand as old as wireless and developed from even older telegraphy codes. Q-signals are a set of abbreviations for common information that save time and allow communication between operators who don't speak a common language. Modern ham radio uses them extensively. The table below lists the most common Q-signals used by hams. While Q-signals were developed for use by Morse operators, their use is common on phone, as well. You will often hear, "QRZed?" as someone asks "Who is calling me?" or "I'm getting a little QRM" from an operator receiving some interference or "Let's QSY to 146.55" as two operators change from a repeater frequency to a nearby simplex communications frequency.

Q-Signals

Abbr.	Questions
QRG	Your exact frequency (or that of _____) is _____kHz. Will you tell me my exact frequency (or that of _____)?
QRL	I am busy (or I am busy with _____). Are you busy? Usually used to see if a frequency is busy.
QRM	Your transmission is being interfered with _____ (1. Nil; 2. Slightly; 3. Moderately; 4. Severely; 5. Extremely.) Is my transmission being interfered with?
QRN	I am troubled by static _____. (1 to 5 as under QRM.) Are you troubled by static?
QRO	Increase power. Shall I increase power?
QRP	Decrease power. Shall I decrease power?
QRQ	Send faster (_____wpm). Shall I send faster?
QRS	Send more slowly (_____wpm). Shall I send more slowly?
QRT	Stop sending. Shall I stop sending?
QRU	I have nothing for you. Have you anything for me?
QRV	I am ready. Are you ready?
QRX	I will call you again at _____hours (on _____kHz). When will you call me again? Minutes are usually implied rather than hours.
QRZ	You are being called by _____ (on _____kHz). Who is calling me?
QSB	Your signals are fading. Are my signals fading?
QSK	I can hear you between signals; break in on my transmission. Can you hear me between your signals and if so can I break in on your transmission?
QSL	I am acknowledging receipt. Can you acknowledge receipt (of a message or transmission)?
QSO	I can communicate with _____ direct (or relay through _____). Can you communicate with _____ direct or by relay?
QSP	I will relay to _____. Will you relay to _____?
QST	General call preceding a message addressed to all amateurs and ARRL members. This is in effect "CQ ARRL."
QSX	I am listening to _____ on _____kHz. Will you listen to _____on _____kHz?
QSY	Change to transmission on another frequency (or on _____kHz). Shall I change to transmission on another frequency (or on _____kHz)?
QTC	I have _____messages for you (or for _____). How many messages have you to send?
QTH	My location is _____. What is your location?
QTR	The time is _____. What is the correct time?

These Q signals are the ones used most often on the air. (Q abbreviations take the form of questions only when they are sent followed by a question mark.)

ITU Phonetic Alphabet

Letter	Word	Pronunciation
A	Alfa	**AL** FAH
B	Bravo	**BRAH** VOH
C	Charlie	**CHAR** LEE
D	Delta	**DELL** TAH
E	Echo	**ECK** OH
F	Foxtrot	**FOKS** TROT
G	Golf	GOLF
H	Hotel	HOH **TELL**
I	India	**IN** DEE AH
J	Juliet	**JEW** LEE ETT
K	Kilo	**KEY** LOH
L	Lima	**LEE** MAH
M	Mike	MIKE
N	November	NO **VEM** BER
O	Oscar	**OSS** CAH
P	Papa	PAH **PAH**
Q	Quebec	KEH **BECK**
R	Romeo	**ROW** ME OH
S	Sierra	SEE **AIR** RAH
T	Tango	TANG GO
U	Uniform	**YOU** NEE FORM
V	Victor	**VIK** TAH
W	Whiskey	**WISS** KEY
X	X-Ray	**ECKS** RAY
Y	Yankee	**YANG** KEY
Z	Zulu	**ZOO** LOO

Note: The **boldfaced** syllables are emphasized. The pronunciations shown in this table were designed for those who speak any of the international languages. The pronunciations given for "Oscar" and "Victor" may seem awkward to English-speaking people in the US.

Continued on Page 19

Communicating with Other Hams *Continued from Page 18*

The RST Signal Reporting System	
Readability	
1	Unreadable.
2	Barely readable, occasional words distinguishable.
3	Readable with considerable difficulty.
4	Readable with practically no difficulty.
5	Perfectly readable.
Signal Strength	
1	Faint signals barely perceptible.
2	Very weak signals.
3	Weak signals.
4	Fair signals.
5	Fairly good signals.
6	Good signals.
7	Moderately strong signals.
8	Strong signals.
9	Extremely strong signals.
Tone (CW and Digital)	
1	Sixty-cycle ac or less, very rough and broad.
2	Very rough ac, very harsh and broad.
3	Rough ac tone, rectified but not filtered.
4	Rough note, some trace of filtering.
5	Filtered rectified ac but strongly ripple-modulated.
6	Filtered tone, definite trace of ripple modulation.
7	Near pure tone, trace of ripple modulation.
8	Near perfect tone, slight trace of modulation.
9	Perfect tone, no trace of ripple or modulation of any kind.

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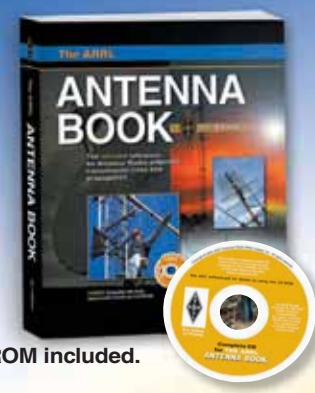

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Your First Station: Pick the Right Hardware for Maximum Enjoyment

Before You Make Your Shopping List, Read This Article!

By Steve Ford, WB8IMY
Editor

Your Amateur Radio station reflects your interests and, naturally, it will change as you explore different facets of the hobby.

But you have to start somewhere, right?

Fortunately, there are some fundamentals that all Amateur Radio stations have in common. Once you understand the basics, you can apply them to your first station and every station thereafter.

The three building blocks of every ham station are:

- Power Supply
- Transceiver
- Antenna System

Let's start with our energy engine: the power supply.

The Power Supply

Without a power supply, a transceiver is a lifeless hunk of metal and plastic. The power supply provides the "juice" that makes ham radio possible.

If you're considering a handheld transceiver for use on VHF or UHF FM, you'll be pleased to know that most of these radios come with their own rechargeable batteries. But if you want to operate the radio without the battery (in your house or apartment, for example), you may want to invest in a small dc power supply—13.8 volts (V) with a current capacity of about 3 amps (A) will do the job nicely. You can find these at retailers such as RadioShack for about $40 or less. With a dc power supply, you won't have to worry about your battery running down when you are in the middle of a conversation.

As you step up to larger radios with more output power, you'll need larger power supplies to run them. Most of these transceivers do not have their own power supplies, so read their specifications before you buy. A transceiver with a maximum output power of 100 W will require about 25 A of current at 13.8 V when you are operating the radio at "full throttle." That kind of power supply will set you back about $100 to $200, depending on the overall design.

Power supplies are rated by how much voltage and current they can provide. Small transceivers will need 13.8 V at about 10 amps. Large transceivers require 13.8V at 25 amps.

Here is a fine stack of directional VHF/UHF antennas.

Don't worry about buying a power supply with too much current capacity. Your equipment will only draw the current it needs—no more, no less. In fact, it is probably safe to say that you can never have too much current capacity. It may seem economically foolish to invest $200 in a 25-A power supply when all you want to power is a handheld radio. However, if you think you'll be upgrading to a larger radio in the near future, you may want to get the big power supply today (especially if you find a great deal on a high-current supply).

Transceivers

As you flip through this booklet you'll see advertising from all the major transceiver manufacturers and dealers. There are so many possibilities to consider, it boggles the mind. Still, there are some common guidelines that apply. Let's break them down according to transceiver type.

VHF/UHF Handheld

Handheld transceivers (often called "HTs," which is a Motorola trade name) are almost exclusively for FM operating, usually with repeaters (we discuss repeaters in another article). The strength of the handheld is its portability. You can clip a handheld to your belt, or slide it into your pocket, and go anywhere.

VHF/UHF Base or Mobile

The next step up the FM ladder is the mobile transceiver. These radios are compact, but not easily portable like a handheld. They usually provide much higher output power, often on the order of 50 W or more. Higher power is critical for good distance coverage, particularly with FM.

HF Only

Remember that the High Frequency or HF bands are defined as those groups of frequencies from 1.8 to 30 MHz. (Technically speaking, 1.8 MHz is in the Medium Frequency or MF region, but we won't argue definitions here!) These are the most popular Amateur Radio bands because they can be used to communicate throughout the world at any time of the day or night.

"DC to Daylight"

The transceiver trend in recent years has been away from HF-only radios. In the 1990s ICOM introduced the IC-706, the first multimode transceiver that spanned the HF bands and the 6- and 2-meter VHF bands. Other manufacturers followed suit and now you'll find transceivers that cover 1.8 to 54 MHz and even 1.8 to 450 MHz in a single box. These so-called "dc to daylight" transceivers are among the most popular radios sold today. It's easy to see why. They offer the ability to enjoy the global coverage of the HF bands while opening the door to the enjoyment of VHF and UHF.

Antennas

When it comes to getting the most enjoyment out of Amateur Radio, there is nothing more important than your antenna system. You can purchase the best ham transceiver on the planet, but if your antenna system is poor, your investment will largely go to waste. If your cash is limited, spend most of it on your antenna system.

Directional Antennas

The most powerful antenna on any band is the directional antenna, often referred to as the beam antenna. These antennas focus your signal in a particular direction (like a flashlight beam). Not only do they concentrate your transmitted signal, they allow you to focus your receive pattern as well. For example, if your beam is aimed west you won't hear many signals from the east (off the "back" of the beam).

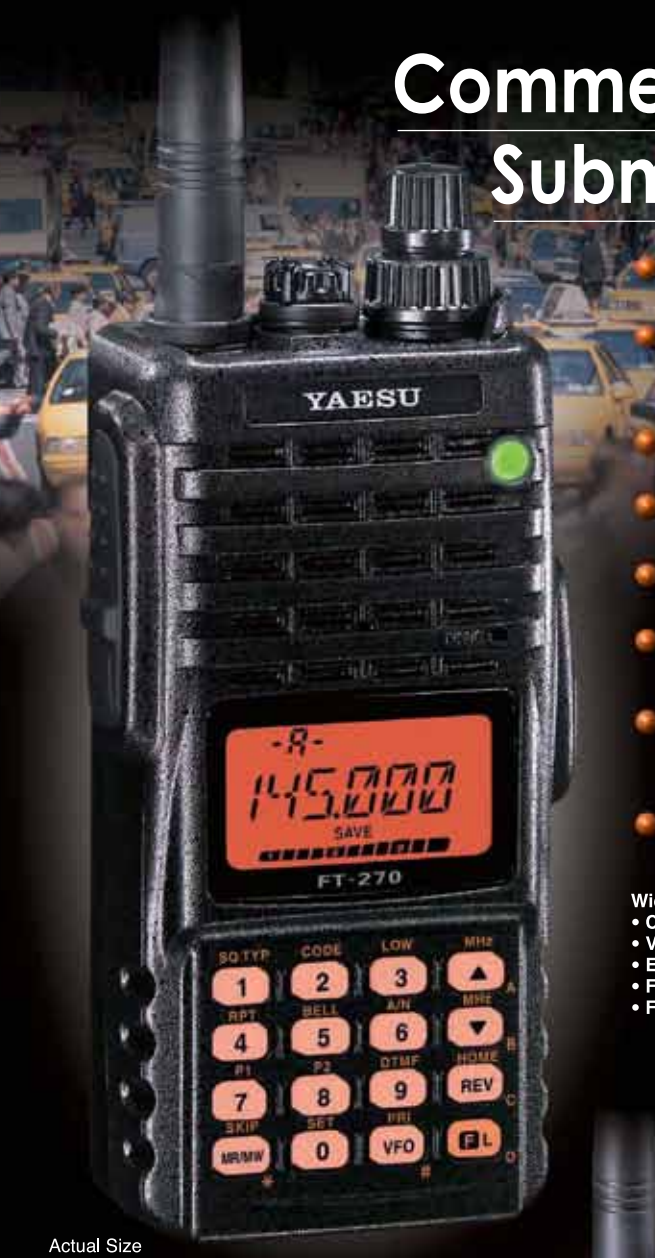
Directional antennas are best when you want maximum distance and minimum interference. They are almost mandatory for long-distance work on the VHF and UHF bands. Beams aren't strictly necessary for the HF bands where they tend to be large and expensive, but if your Amateur Radio adventures take you to HF frequencies, beam antennas can give you a big advantage.

Simple Antennas

The simplest antennas are the omnidirectionals, which is another way of saying that they receive and transmit in every direction at once (more or less). All commonly used mobile antennas are omnidirectional. This makes sense because it is impractical to stop and point your car in the direction of the station you want to contact. Instead, the omnidirectional mobile antenna blasts your signal in all directions so that you'll stand a decent chance of communicating no matter where you are driving.

Omnidirectional antennas are also found in base stations where the goal is to transmit and receive from any direction with minimal hassle and expense. Common omnidirectional antenna designs for base stations include ground planes (such as the homemade one you'll find in this booklet), loops and J-poles, but there are others.

Commercial Grade Field Radio
Submersible Construction



- Large Backlit LCD Display for easy operation
- 5 Watts of Stable RF Power with Minimum Components for Reliability
- 800 mW of Loud Audio for noisy field operations
- 200 Memory Channels for Serious users
- Commercial Grade Receivers Performance
- Submersible Construction (3 ft. for 30 min)
- Yaesu Exclusive Power Saving Circuit Design Guarantees Longer Operating time
- Hands Free Operation with Optional VC-24 VOX Headset

Wide Range of available Options includes:
- CD-26 Charger Cradle
- VAC-370B 1.5 Hour Desktop Rapid Charger
- External DC Jack for Cigarette-Lighter adapter E-DC-5B or DC Cable E-DC-6
- FBA-25A Alkaline Battery Case (for 6 X AA cells)
- FTD-7 DTMF Paging Unit

Actual Size

VHF FM 5 W COMPACT HANDHELD TRANSCEIVER

FT-270R

Size: 2.4" (W) x 4.7" (H) x 1.3" (D) Weight: 13.8 oz.

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Compact Field Radio with
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- Compact Design with Top mounted LCD Display
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- 200 Memory Channels for serious users
- Yaesu Exclusive Power Saving Circuit Design Guarantees Longer Operating time
- Hands Free Operation with Optional VC-25 VOX Headset

Wide Range of available Options includes:
- External DC jack for Cigarette-Lighter adapter E-DC-5B or DC cable E-DC-6
- 6 X AA size Alkaline Battery Case FBA-25A

ULTRA-COMPACT 5 W 2 m FM HANDHELD TRANSCEIVER

FT-250R

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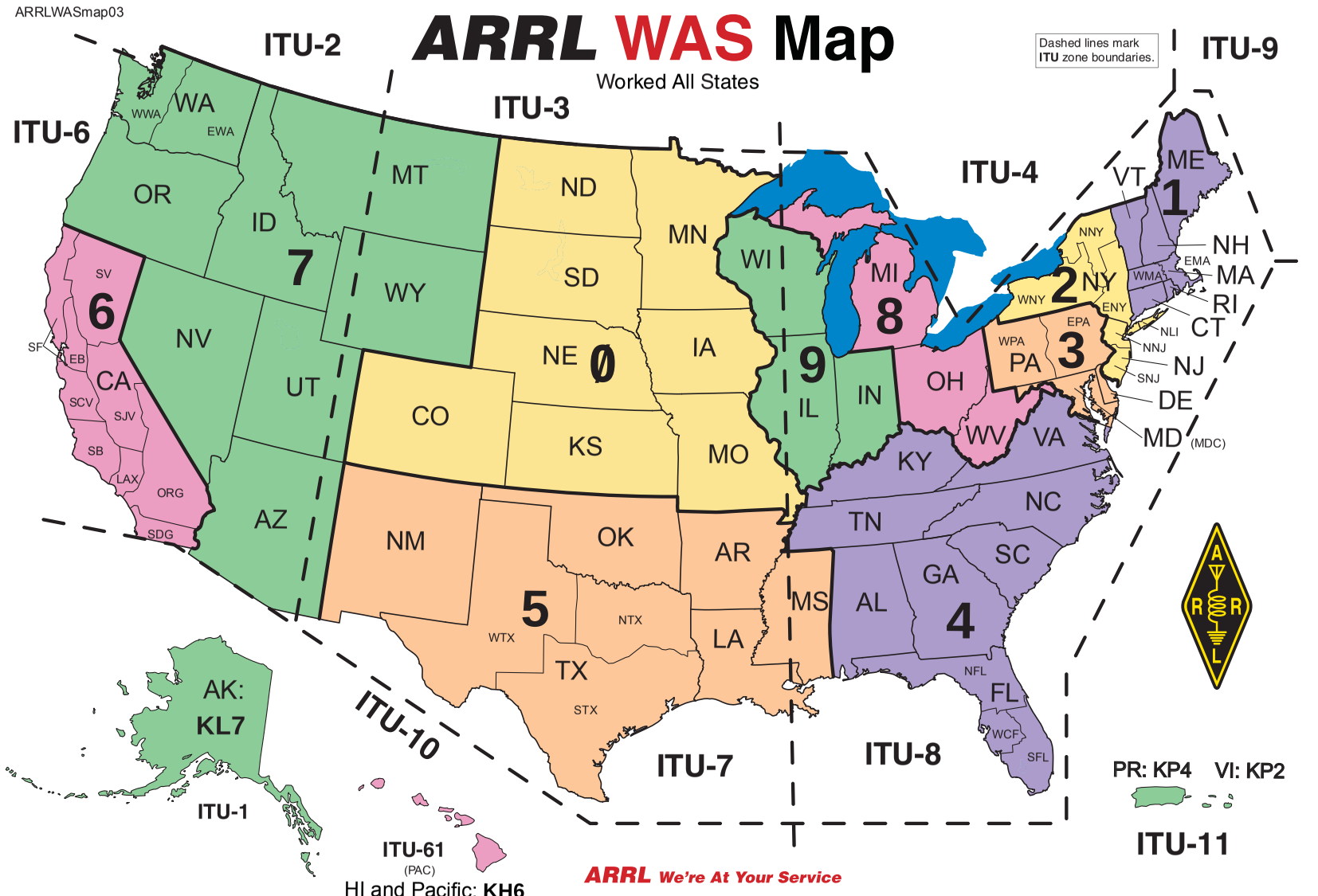
Specifications subject to change without notice. Some accessories and/or options may be standard in certain areas. Frequency coverage may differ in some countries. Check with your local Yaesu Dealer for specific details.



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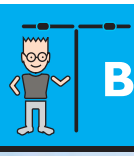
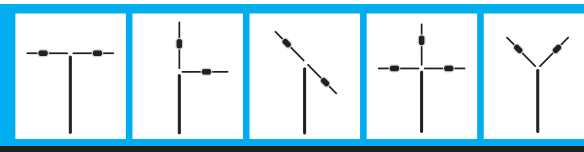


BUDDIPOLE



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- Multi-band design works 9 bands (40 meters thru 2 meters) with one set of adjustable coils!
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US Amateur Radio Bands

US AMATEUR POWER LIMITS

At all times, transmitter power should be kept down to that necessary to carry out the desired communications. Power is rated in watts PEP output. Except where noted, the maximum power output is *1500 Watts*.

Effective Date
May 6, 2008

Published by:
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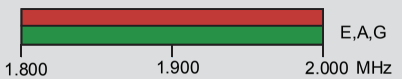
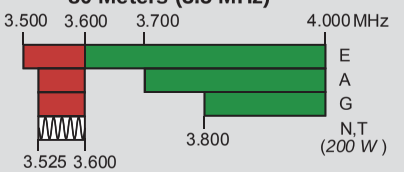
www.arrl.org
225 Main Street, Newington, CT USA 06111-1494

160 Meters (1.8 MHz)

Avoid interference to radiolocation operations from 1.900 to 2.000 MHz

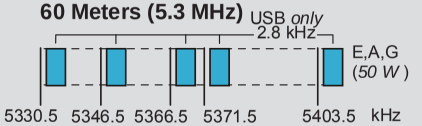


80 Meters (3.5 MHz)



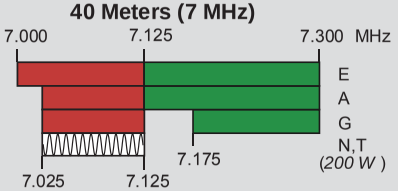
60 Meters (5.3 MHz)

USB *only*



General, Advanced, and Amateur Extra licensees may use the following five channels on a secondary basis with a maximum effective radiated power of 50 W PEP relative to a half wave dipole. Only upper sideband suppressed carrier voice transmissions may be used. The frequencies are 5330.5, 5346.5, 5366.5, 5371.5 and 5403.5 kHz. The occupied bandwidth is limited to 2.8 kHz centered on 5332, 5348, 5368, 5373, and 5405 kHz respectively.

40 Meters (7 MHz)

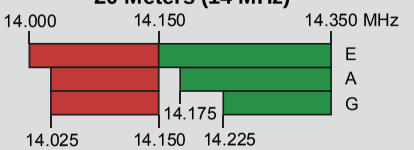


Phone and Image modes are permitted between 7.075 and 7.100 MHz for FCC licensed stations in ITU Regions 1 and 3 and by FCC licensed stations in ITU Region 2 West of 130 degrees West longitude or South of 20 degrees North latitude. See Sections 97.305(c) and 97.307(f)(11).
Novice and Technician licensees outside ITU Region 2 may use CW only between 7.025 and 7.075 MHz and between 7.100 and 7.125 MHz. 7.200 to 7.300 MHz is not available outside ITU Region 2. See Section 97.301(e). These exemptions do not apply to stations in the continental US.

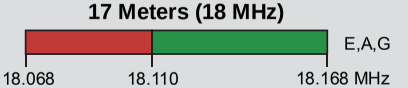
30 Meters (10.1 MHz)

Avoid interference to fixed services outside the US.

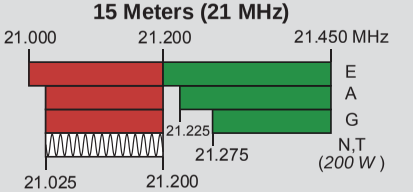
20 Meters (14 MHz)



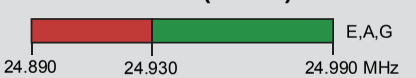
17 Meters (18 MHz)



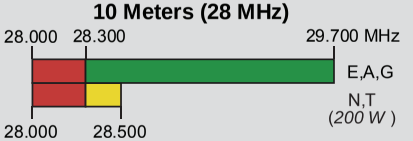
15 Meters (21 MHz)



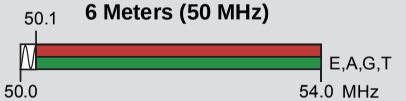
12 Meters (24 MHz)



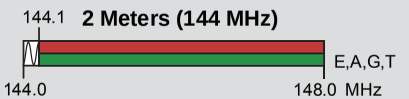
10 Meters (28 MHz)



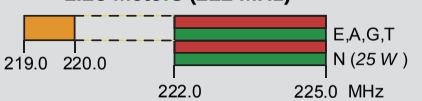
6 Meters (50 MHz)



2 Meters (144 MHz)



1.25 Meters (222 MHz)

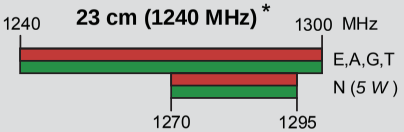


*Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.

70 cm (420 MHz)*

33 cm (902 MHz)*

23 cm (1240 MHz)*



All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

KEY

Note:
CW operation is permitted throughout all amateur bands except 60 meters.

MCW is authorized above 50.1 MHz, except for 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz

- = RTTY and data
- = phone and image
- = CW *only*
- = SSB phone
- = USB phone *only*
- = Fixed digital message forwarding systems *only*

E = Amateur Extra
A = Advanced
G = General
T = Technician
N = Novice

See *ARRLWeb* at *www.arrl.org* for more detailed band plans.

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Changes in the 60 meter band are pending and will be made within the next year. Please visit www.arrl.org for the latest Amateur Radio band information.

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Open a world of opportunity by volunteering

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Helpful Hints Quiz for New Hams, V.4

(or, things you should have learned in ham class but were not on the test!)

ADVERTISEMENT

1) What does a "triple band-stacking register" do?

A Works three stations at once
B Makes radios smaller
C Saves up to three VFO settings
D Pre-order your breakfast

2) "Barefoot" means operating without a...

A Beam antenna
B CW keyer
C Power amplifier
D Clean pair of socks

3) Whick manufacturer offers D-STAR equipment in the USA?

A Icom
B Ten-Tec
C Kenwood
D Yaesu

4) D-PRS stands for...

A Direct-Powered Repeater System
B D-STAR-Personal Radio Service
C Developers' Personal Radio Service
D D-STAR-Position Reporting System

5) Which filter would help you hear a CW signal better?

A High-pass
B Notch
C HEPA
D Band-pass

6) What does an automatic tuning unit (ATU) change?

A Impedance
B Power
C Antenna length
D Takeoff angle

7) What would you use a rotator for?

A Tuning a radio
B Pointing a beam antenna
C Winding up loose cables
D Correcting excessive SWR

8) Which type of propagation brings in far-away stations?

A Ground wave
B Line-of-sight
C Multi-path
D Skip

9) What does a "bureau" exchange with foreign hams?

A Antenna design articles
B Old magazines
C QSL cards
D Reports of illegal activity

10) What causes "picket fencing" on a mobile station's VHF signal?

A Multi-path propagation
B Poor voltage regulation
C Excessive stereo bass levels
D Driving through a rural area

11) What measurement relates a radio wave's frequency and wavelength?

A Voltage
B Velocity
C Time
D Resistance

12) What does "emcomm" mean?

A Emergency communications
B Mobile communications
C Communications about Auntie Em
D EM refers to a type of modulation

ANSWERS: ***1)C****; The band-stacking register stores three different VFO band-and-mode combinations for quick recall.* ***2)C****; An amplifier is sometimes called "a pair of shoes", so turning the amplifier off means "going barefoot".* ***3)A****; D-STAR is an open standard, but no other manufacturers yet offer D-STAR to North American hams.* ***4)D****; D-PRS allows D-STAR radios to send GPS information to the Automatic Position Reporting System.* ***5)D****; Band-pass filters reject higher and lower pitches so you can hear Morse tones more clearly.* ***6)A****; The ATU changes the impedance of an antenna to match the impedance of a feed line.* ***7)B****; A rotator turns a mast on which a beam antenna is mounted.* ***8)D****; Signals that are reflected by - or "skip" off - the ionosphere are returned to Earth a long distance away.* ***9)C****; QSL cards.* ***10)A****; Multiple paths for a signal cause partial cancelling in a rapid fluttering pattern.* ***11)B****; Radio signals always travel at the speed of light so they have a fixed relationship between their frequency and wavelength.* ***12)A****; Emergency communications is a primary reason for Amateur Radio's existence!*

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IC-7000 COMPACT MULTI-BAND RIG

The 7000 carries on the torch of Icom's famous 706 series: lots of bands and lots of features, all in one little go-anywhere package. HF/6M/2M/70CM, 2 - 100 Watts of output power on HF (40W AM), digital IF filters, digital voice recorder. Whether you're new to HF or a seasoned pro, the 7000 is one fun rig.

IC-7200 RUGGEDIZED PERFORMANCE

The 7200 is the rig of choice for HF + 6M ham ops in rugged environments. MARS-ready right out of the box, 100 watts and a huge heat sink make for heavy duty operation in all kinds of challenging conditions. Yet the radio is small enough to go anywhere you go! You'll get big-guns performance from the 32 Bit IF-DSP + 24 Bit AD/DA converter, and advanced digital functions like twin passband tuning and selectable filter width & shape, give on-the-move operations a base station level of performance.

IC-718 ICOM'S MOST BASIC HF

Don't let "basic" fool you, the 718 offers 100% Icom performance and features you'd expect in a higer-priced rig. Get 100 watt output, one-touch band switching, RF gain control, a built-in CW keyer/VOX, built-in DSP, and more. The 718 is a perfect starter HF tool, and it makes a great second station radio.

IC-7600 THE DX'PEDITION FAVORITE

Compact and powerful, this HF + 6M transceiver shares many top-end specs found in higher-priced rigs. You'll get +30dBm 3rd order intercept point, 3 roofing filters, a built-in digital filter with selectable width/shape, specialized USB ports, transmit modulation & audio receive, and more. Perfect for the shack on a tropical beach, or the shack in your home.

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*Frequency specs may vary. Refer to owner's manual for exact frequency specs.

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